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Original article

Incidence, mortality and survival from prostate cancer in Vaud and Neuchâtel, Switzerland, 1974–1994

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Summary

Backround: Prostate cancer incidence has been increasing in most developed countries in the absence of similar trends in mortality, and with variable patterns in different areas of the world.

Materials and methods: Trends in incidence and mortality from prostate cancer for the period 1974–1994 were analysed using data from the Cancer Registries of the Swiss Cantons of Vaud and Neuchâtel. Of 5,010 cases registered, 80% were histologically or cytologically confirmed.

Results: Age-standardized incidence rates increased from 33.1 to 48.6 per 100,000 (+47%). The upward trends were greater in the most recent calendar periods, and in the younger age groups (+77% at age 45 to 54; +57% at age 55 to 64). In contrast, mortality was stable, with an overall increase of only 3% in age-standardized rates (from 20.4 to 21.0 per 100,000), due to some increase in men aged 65 or above. Consequently, the incidence/mortality rate ratios increased from 1.6 in 1974–1979 to 2.3 in 1990–1994. Five-year observed and relative survivals increased from 26% to 41% and from 46% to 58%, respectively. Ten-year observed and relative survival for cases diagnosed in 1985–1989 were 19% and 42%, respectively. Survival improvements were greater below age 75.

Conclusions: The pattern of trends in incidence, mortality and survival confirms the influence of improved diagnosis of prostate cancer over the last few years in this European population. Still, while Swiss prostatic cancer mortality rates are the highest in the world (20.3 per 100,000, world standard), i.e., about 30% higher than in the United States, all races combined, incidence rates are still half as much. On account of the steady increase of prostate-specific antigen testing in Switzerland, further incidence increases are likely.

Key words: cancer, incidence, mortality, prostate, registry, screening, survival, time trends

Over the last decade in the United States (US) and Canada there has been a dramatic, and in several aspects, unprecedented rise in incidence of prostate cancer, which has become the first site of incidence in American men. These upward trends have been observed in various age groups, including the youngest ones, i.e., between 50 and 59 years, and were not reflected in changes in mortality, which rose only moderately, mainly in the elderly [1–8].

These trends have been interpreted in terms of increased awareness and surveillance of prostate cancer, including rises in biopsies and transurethral resections of the prostate (TURP) for the treatment of benign prostatic hyperplasia. Possibly most important, serum prostate-specific antigen (PSA) has been widely adopted as test for screening and early diagnosis, particularly after 1989 [9]. The increase was largely due to localized and regional cancer, and led to substantial rise in radical prostatectomies, which more than tripled between 1983 and 1989 in all SEER areas, although substantial geographic differences were evident also within the US [8]. Recent data from some areas in the US, however, show a levelling off and a reversal of incidence trends, possibly following the removal of many prevalent cases [5, 7, 10–12]. No decline is as yet evident on mortality. There is also some evidence that the rate of advanced cancer has fallen in the early 1990s [10, 13].

Only scanty information on countries other than the US is available. A comparison of incidence, survival and mortality rates in Nordic countries in 1983–1987 showed that mortality was similar (around 30 per 100,000) in all countries, but incidence ranged from 48.9 per 100,000 in Denmark to 82.6 per 100,000 in Sweden, pointing to the existence of potential differences in diagnostic intensity in various countries [14]. A study from the Netherlands [15] showed a steady rise in mortality, particularly in the elderly, and another from England and Wales [16] reported only moderate upward trends in incidence over the period 1971–1986 and in mortality over the period 1970–1990. An analysis of trends between 1957 and 1991 in Norway [17] showed a rise in age-adjusted incidence rates from 26.3 to 46.6 per 100,000, in the absence of major changes in slope over time, and a similar trend in mortality. A levelling of death rates was observed from the mid 1970s onwards [17]. In South Australia [18], incidence of prostate cancer was approximately stable between 1977 and 1989, but increased by over a third by

Table 1. Basis of diagnosis for prostate cancer by calendar period. Vaud and Neuchâtel Cantons, Switzerland, 1974–1994.

Basis of diagnosis	Calendar period							
	1974–1979		1980–1984		1985–1989		1990–1994	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Histology and/or cytology	840	(79.5)	817	(79.7)	1122	(84.4)	1394	(87.1)
Autopsy finding	98	(9.3)	84	(8.2)	69	(5.2)	66	(4.1)
Clinical examination only	118	(11.2)	124	(12.1)	138	(10.4)	140	(8.8)
Total, all cases	1056	(100.0)	1025	(100.0)	1329	(100.0)	1600	(100.0)

1993. In the same period, there was only a moderate increase in mortality. Similar trends were observed up to 1994 in New South Wales and other Australian States [19], and were correlated with rising rates of PSA testing, transurethral ultrasound, prostate biopsy, TURP and prostatectomy.

Recent data on survival after prostate cancer diagnosis are available on few countries. Improvements have been reported in the US, where relative five-year survival in Whites rose from 63% in 1970–1973 to 88% in 1986–1991 [20]. In approximately the same period survival also improved, but to a lesser extent, in Nordic countries (from below 50% to slightly above 60%) [17, 21, 22].

It is, therefore, interesting to consider trends in prostate cancer incidence and mortality from other countries. Switzerland, in particular, has the highest death certification rates from prostate cancer in the world, i.e., over 30% higher than the overall US rate, and hence the highest rates in any white population worldwide [23]. Little is known, however, on the epidemiology of the disease in this area of the world. We analysed, therefore, incidence, mortality and survival data from the Cancer Registries of the Swiss Cantons of Vaud and Neuchâtel.

Materials and methods

Data presented in this report were abstracted from the Vaud and Neuchâtel Cancer Registries files, which include incident cases of malignant neoplasms in the cantons [24, 25] whose populations, according to the 1990 Census, were about 602,000 and 164,000 inhabitants, respectively. In these cantons, cancer registration systems have been implemented since 1972, and population-based incidence data have been available since 1974. The registries are tumour-based, and multiple primaries in the same person are entered separately. Most cases are registered repeatedly and from different institutions, thus improving completeness and accuracy of registration. The basic information available comprises sociodemographic characteristics of the patient, primary site and histological type of the tumour according to the standard International Classification of Diseases for Oncology (ICD-O) [26], and date of diagnostic confirmation (histological or clinical diagnosis). Active follow-up is recorded, and each subsequent item of information concerning an already registered case is used to complete the records of that patient.

The present series comprises a total of 5010 new malignant primary prostatic cancers (ICD-O topography: 185.9) [26] diagnosed between 1974 and 1994 in the resident populations of Vaud (n = 3915) and Neuchâtel (n = 1095). The age range was 41–102 years (median age, 75 years). No information was available on stage and on treatment of the disease. Death certification numbers were abstracted from registries provided by the Swiss Federal Statistical Office. All certified deaths from prostatic cancer (ICD Eighth Revision, code 185) in the populations of Vaud (n = 2152) and Neuchâtel (n = 652) during the period 1974–1994 were considered.

Age-standardized incidence and mortality rates were computed by the direct method (on the world standard population) per 100,000 population for four subsequent calendar periods and age groups.

Information on survival is routinely integrated into the registry data file from the official mortality statistics available yearly on magnetic tape. As a further step, 'apparently' non deceased cases are actively followed-up through the verification of their vital status from registries of current residence. The vital status of each prostatic cancer included in this analysis has been thus confirmed up to December 1996.

Using the product limit (maximum likelihood) [27] method, survival curves were defined for the whole series by calendar period and age group; differences between subgroups were assessed by means of the log-rank test [28]. Two-, five- and 10-year relative survival rates [29] were computed, after allowance for the general lifetables of the cantons.

In order to describe the concurrent changes in PSA testing, the major laboratories in the Cantons of Vaud and Neuchâtel were asked to provide the number of PSA examinations performed in the years between 1985 and 1996.

Results

Table 1 gives the distribution of prostate cancers diagnosed between 1974 and 1994 according to diagnosic modality and calendar period. There was a steady tendency of histologically confirmed cases to increase (from 80% in 1974–1979 to 87% in 1990–1994), and of those incidentally found only at autopsy or by clinical examination to decline.

Table 2 gives age-specific and overall crude and age-standardized incidence rates of prostate cancer in subsequent calendar periods. Substantial upward trends were recorded, ranging from an increase of 77% in age group 45–54 to one of 37% in age group 75 years and above. All-age standardized incidence rates rose from 33 to 49 per 100,000 (+47%). The absolute number of cases per year changed from an average of 176 in 1974–1979 to 320 in 1990–1994.

Corresponding figures for mortality are given in Table 3. Standardized rates were stable, from 20.4 in 1974–1979 to 21.0 per 100,000 in 1990–1994 (+3%). Whereas 7%–8% increases were observed in mortality rates in the elderly (i.e., 65–74 and $\geqslant$ 75 years), some

Table 2. Incidence of prostate cancer per 100,000 man years by age and period of diagnosis. Vaud and Neuchâtel, Switzerland, 1974–1994.

	Calendar period				Percent change[a]
	1974–1979	1980–1984	1985–1989	1990–1994	
Age group					
45–54	4.7	4.4	9.0	8.3	+76.6
55–64	70.1	66.8	87.9	110.3	+57.3
65–74	278.4	295.9	342.5	424.2	+52.4
⩾75	645.3	727.6	875.0	882.6	+36.8
Crude rate (all ages)	55.0	63.7	79.0	89.0	+61.8
Age-standardized[b] rate	33.1	35.2	42.7	48.6	+46.8
Number of cases per year	176	205	266	320	+81.8

[a] From 1974–1979 to 1990–1994.
[b] Standardized on the world population.

Table 3. Death certification rates for prostate cancer per 100,000 man years by age and period of diagnosis. Vaud and Neuchâtel, Switzerland, 1974–1994.

	Calendar period				Percent change[a]
	1974–1979	1980–1984	1985–1989	1990–1994	
Age group					
45–54	1.6	1.4	4.0	0.4	−75.0
55–64	25.6	21.4	23.4	19.9	−22.3
65–74	128.9	135.8	128.6	139.2	+8.0
⩾75	582.1	584.2	657.8	619.7	+6.5
Crude rate (all ages)	33.9	39.0	43.9	43.8	+29.2
Age-standardized[b] rate	20.4	20.3	21.9	21.0	+2.9
Incidence/mortality[b] rate ratio	1.6	1.7	1.9	2.3	+43.8
Number of deaths per year	109	126	148	157	+44.0

[a] From 1974–1979 to 1990–1994.
[b] Standardized on the world population.

decline emerged in middle-age men, though based on few deaths. Incidence-to-mortality rate ratios increased from 1.6 to 2.3. Yearly number of deaths from cancer of the prostate increased from an average of 109 to 157 in 1990–1994.

In Figure 1, the increasing gap between incidence and mortality three-year rates since 1983–1985 clearly emerges. The later rise in the number of PSA tests performed in the cantons of Vaud and Neuchâtel is also shown, from none in 1986–1988, to 2737 in 1989–1991, and to 20,734 in 1992–1994. In 1996, at least 11,854 PSA tests were reported.

Table 4 gives the two-, five- and 10-year observed and relative survival rate of prostate cancers diagnosed in the aforementioned periods. Observed five-year survival at all ages improved, from 26.4% in prostate cancer patients diagnosed in 1974–1979 to 41.4% in those diagnosed in 1990–1994. Survival increases were similar in the age groups <65 and 65–74 years, but were modest above 75 years of age (from 27.3 to 30.1). Also two-year and 10-year survival showed some amelioration and relative survival rates were consistent with, but higher than observed survival (Table 4). Ten-year relative survival increased from 26.4% in 1974–1979 cases to 42.2% in 1985–1989 cases.

Discussion

The present report, one of the few available from European areas [14–17], confirms that also in this population the incidence of prostate cancer has substantially increased, particularly during the last decade and that – in relative terms – the increase has been larger in men below age 75 years. Five-year relative survival has also increased from 46% to 58%, a change that cannot be accounted for by changes in treatment [6, 9, 11]. Mortality, in contrast, has been stable, with a modest rise only in the elderly. In the mid 1970s there were 1.6 new cases per each death from prostate cancer, whereas in 1990–1994 this ratio became 2.3.

While it is unlikely that these frequencies have been appreciably affected by changes in completeness of cancer registration in these areas, which has not changed over the period considered [24, 25], these trend patterns confirm the influence of diagnostic anticipation and/or improvements over the last decade [9, 11]. These changes in incidence can be compared with data on number of

Table 4. Observed and relative survival rates (%) for prostate cancer by age and calendar period. Vaud and Neuchâtel, Switzerland, 1974–1994.

Age group (years)	Survival	Calendar period										
		1974–1979			1980–1984			1985–1989			1990–1994	
		2-year	5-year	10-year	2-year	5-year	10-year	2-year	5-year	10-year	2-year	5-year
<65	Observed	67.9	38.5 (2.2)[a]	16.0	69.2	44.0 (2.3)	17.6	80.2	51.1 (2.1)	29.2	77.3	53.8 (3.0)
	Relative	71.2	44.5	25.3	74.3	47.6	27.1	84.7	61.2	44.3	84.9	65.5
65–74	Observed	67.6	37.7 (2.5)	14.7	68.3	44.2 (2.7)	16.5	79.5	49.2 (2.5)	26.9	75.6	51.7 (2.8)
	Relative	73.1	47.2	25.6	74.1	55.5	29.0	86.2	61.7	47.7	81.7	64.3
⩾75	Observed	55.6	27.3 (2.2)	8.5	55.4	25.4 (2.1)	7.9	59.7	27.9 (1.8)	10.0	60.5	30.1 (2.7)
	Relative	66.5	45.1	29.1	66.8	42.7	24.8	71.8	46.8	35.1	72.6	50.2
All ages	Observed	62.4	26.4 (1.6)	12.7	62.5	34.9 (1.6)	12.5	69.4	38.9 (1.4)	19.1	68.5	41.4 (2.1)
	Relative	70.0	45.9	26.4	70.8	49.0	27.3	78.7	54.8	42.2	77.6	58.2

[a] Standard deviation is given in parentheses.

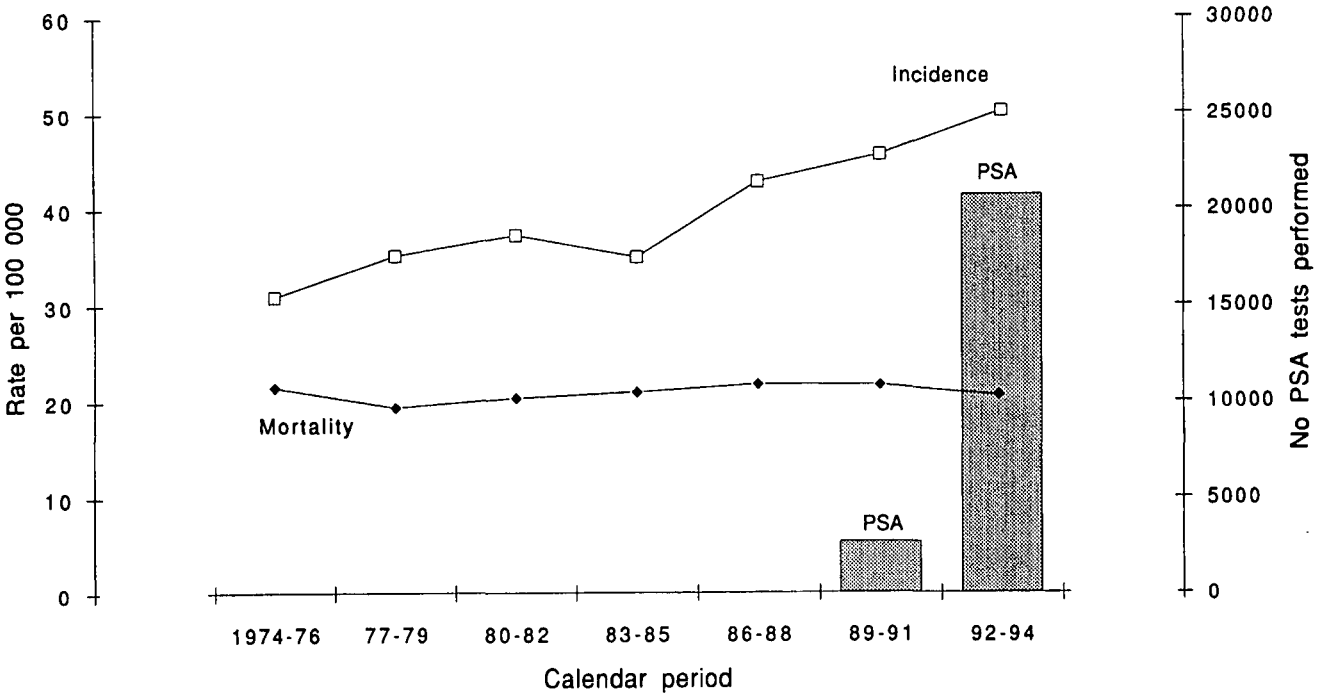

Figure 1. Trends in three-year age-standardized (world population) incidence and mortality rates of prostate cancer, and of the number of PSA tests performed. Vaud and Neuchâtel Cantons, Switzerland, 1974–1994.

PSA tests from major (public and private) laboratories in the Cantons of Vaud and Neuchâtel. PSA testing was introduced in 1989, reaching levels of 12,000 PSA tests per year in 1995 and 1996. Thus, even in the absence of any organized screening program, it can be estimated that in the early 1990s at least 10% of men aged 65 or more in the study areas may have undergone PSA testing. Although no reliable data on indication are available, a large proportion of these tests are likely to be for screening, rather than diagnosis or follow-up purposes. Still, such percentage is approximately half as that estimated in some areas of the US [4]. However, since the increase in prostatic cancer incidence precedes in part the spread of PSA testing, it is clear that other factors had been already operating in the 1980s, including the increase in the number of biopsies and TURP for prostatic benign hyperplasia, and the relatively frequent practice of rectal examination. In 1992–1993, for instance, in the Canton of Vaud 17% of men aged 50–64 and 27% of those aged 65 or more years reported to have had rectal examination in the previous 12 months [30].

Still, while Swiss prostatic cancer mortality rates are the highest in the world (i.e., 22 per 100,000 vs. 17 per 100,000 in the US, all races combined, in 1988–1992), incidence rates are still considerably lower than those of North America (i.e., 47 per 100,000 in Vaud and Neuchâtel *versus* 102 per 100,000 in the US) [20]. A marked gap also persists with respect to prostate cancer survival, despite the reported improvements. Five-year relative survival rates in cases diagnosed between 1986 and 1991 were in the US 86% for all races and 88% for white males, as compared to about 58% in Vaud and Neuchâtel. Survival rates in this study are, however, similar to those reported (about 60%) in the late 1980s in Sweden, overall and in specific age groups [14, 21, 22].

It is therefore likely that the rise in prostatic cancer incidence will continue in the near future in this population where PSA screening is in an earlier phase than in North America, while a reversal of trends is already evident in the US [11]. The traditionally high mortality rates of prostatic cancer in Switzerland provides also a privileged context in order to assess any favourable impact of diagnostic improvements.

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